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THESIS

SAFETY RISK MANAGEMENT FOR HOMELAND DEFENSE AND SECURITY RESPONDERS

by

Tommey H. Meyers

September 2005

Thesis Advisor:	Paul Pitman
Second Reader:	Brian Jackson

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13. ABSTRACT

Responders at the Federal, state, and local level are critical to Homeland Defense and Security (HLDS). Building from the recently published RAND and National Institute of Occupational Safety and Health (NIOSH) report on responder safety, this thesis explores the issues associated with creating a safety risk management capability that will enable HLDS responders to better protect themselves from harm and enhance their readiness. Risk management experiences within the military were benchmarked with emphasis upon lessons learned from the U.S. Coast Guard and the U.S. Navy. This revealed that Operational Risk Management (ORM), a risk-based decision-making tool that systematically balances risk and mission completion, and Crew Resource Management (CRM), a human factors-based team coordination training, should be the primary components focused upon to build the safety risk management capability. Development of ORM and CRM capabilities for HLDS responders will require strong national and local leadership, innovative measurement tools, clear accountability, and should be implemented via the national preparedness model outlined in Homeland Security Presidential Directive 5 (HSPD-5) and HSPD-8. ORM and CRM, if successfully established, can provide HLDS responders with the safety risk management capability that enables them to safely and effectively provide their vital services to the Nation.

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SAFETY RISK MANAGEMENT FOR HOMELAND DEFENSE AND SECURITY RESPONDERS

Tommey H. Meyers
Commander, United States Coast Guard
M.S., University of Washington, 1997
B.S., U.S. Coast Guard Academy, 1986

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September 2005

Author: Tommey H. Meyers

Approved by: Paul Pitman
Thesis Advisor

Brian Jackson
Second Reader

Douglas Porch, PhD
Chairman, National Security Affairs

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ABSTRACT

Responders at the Federal, state, and local level are critical to Homeland Defense and Security (HLDS). Building from the recently published RAND and National Institute of Occupational Safety and Health (NIOSH) report on responder safety, this thesis explores the issues associated with creating a safety risk management capability that will enable HLDS responders to better protect themselves from harm and enhance their readiness. Risk management experiences within the military were benchmarked with emphasis upon lessons learned from the U.S. Coast Guard and the U.S. Navy. This revealed that Operational Risk Management (ORM), a risk-based decision-making tool that systematically balances risk and mission completion, and Crew Resource Management (CRM), a human factors-based team coordination training, should be the primary components focused upon to build the safety risk management capability. Development of ORM and CRM capabilities for HLDS responders will require strong national and local leadership, innovative measurement tools, clear accountability, and should be implemented via the national preparedness model outlined in Homeland Security Presidential Directive 5 (HSPD-5) and HSPD-8. ORM and CRM, if successfully established, can provide HLDS responders with the safety risk management capability that enables them to safely and effectively provide their vital services to the Nation.

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I. INTRODUCTION

A. SEMPER NECESSARIUS

The National Strategy for Homeland Security (NSHS) outlines an approach for the Nation built upon prevention, protection, response, and recovery (United States 2002). While this strategy stresses the need to improve our National capabilities against an intentional attack like those of 9-11, it also makes clear that this approach is equally aimed at preparing the Nation for major accidents and natural disasters. Significant resources and effort have been expended upon improving the Nation's abilities across the spectrum of these activities but the primary focus has been upon prevention. The overhaul and dramatic restructuring of our intelligence community as well as extensive diplomatic and military action overseas were specifically undertaken with the intent of preventing further attacks. Even if these prevention efforts are so successful that every attack against the Nation is thwarted, there will clearly still be a need for response to and recovery from the impacts of earthquakes, hazardous materials releases, hurricanes, volcanoes, and floods. Whether a terrorist "gets lucky" and breaks through our defenses to launch an attack or if Mother Nature simply "does her thing," the Nation and thousands of constituent communities will *always have a need* for their firefighters, law enforcement, and emergency medical personnel - our Homeland Defense and Security (HLDS) responders - to be ready to provide an effective response and recovery.

Every time emergency responders go into action, they put their lives on the line. The potential for negative impacts upon health and safety is higher in responses to major natural disasters and terrorist attacks, but it is always present, even for routine actions. While protecting responders is an important goal in and of itself, their safety is also crucial to HLDS and to the effectiveness of the Nation's response force. Emergency responders are a critical element of our national strategy and it is vital to protect them from the inherent hazards of response work, not just for their good, or the good of their community, but for the entire Nation. Injuries and occupational illnesses, both physical and psychological, immediately harm the individuals, their families, and their communities. From a strategic standpoint, they negatively impact an organizations' preparedness and capability to perform necessary missions in the short and long term.

When HLDS responders are injured or are incapacitated by work-related illnesses, it not only precludes their reaction to an emergency today but may also make them unavailable for a disaster or attack in the future. While it is clear that the hazards faced by responders can never be eliminated, much can be done to manage the risks involved, protect them as fully as possible, create opportunities for mission success, and ultimately enable them to more effectively fill their critical role within the National Strategy.

B. A CALL FOR ACTION: THE RAND/NIOSH REPORT

To address issues related to the safety of responders, the RAND Corporation and the National Institute for Occupational Safety and Health (NIOSH) collaborated almost immediately following the attacks of 9-11. They focused on preparedness, especially planning and training, and upon safety management as a means of controlling the hazards faced by emergency responders. The study, recently published in a series of reports, combined an analysis of the systems and practices outlined in emergency response literature with firsthand experience and suggestions obtained from an extensive series of interviews with HLDS responders. These included interviews with 70 emergency responders who were at the World Trade Center or at the Pentagon on and after September 11, at the Northridge earthquake (in California) or at Hurricane Andrew (in Florida); interviews with approximately 20 additional experts from the response community; and roundtable discussions with more than 100 members of the responder community (including this author) with experience, expertise, and interest in safety and health management issues who attended a 2003 RAND workshop. The reports reflect input from firefighting, law enforcement, emergency medical services, public health, skilled support and trades, public works, disaster relief, local and state governments, and professional organizations, as well as key federal agencies involved with response: NIOSH; the Centers for Disease Control and Prevention; the U.S. Coast Guard (USCG); the Department of Defense (DOD) and three of the DOD services—the Army (including the Army Corps of Engineers), the Navy, and the Marine Corps; the Department of Justice; the Environmental Protection Agency; The Federal Emergency Management Administration; the National Institute of Environmental Health Sciences; the Occupational Safety and Health Administration; and the White House Office of Science and Technology Policy. The third of those reports, “Protecting Emergency Responders,

Vol. 3, Safety Management In Disaster and Terrorism Response," primarily authored by Brian Jackson and cited as (Jackson 2004), is referred to simply throughout this thesis as "the RAND/NIOSH report" or more simply "RAND/NIOSH." It provides the primary impetus for this thesis: Examining how to develop a safety risk management approach for HLDS responders that improves their safety and effectiveness.

RAND/NIOSH outlines the requirements for a safety management approach for HLDS responders by first clarifying that the stakeholders are those "career responders and volunteers typically labeled as emergency responders—emergency management, fire service, law enforcement, and emergency medical service responders," as well as a range of other disaster response workers such as "federal, state, and local personnel; public health professionals; skilled support personnel (including construction/demolition workers, transit workers, and utility services workers); disaster relief workers; and members of volunteer organizations" (Jackson 2004). It then mandates a safety management approach for these stakeholders, noting that "all disasters present risks to emergency response workers—risks that may be familiar or unfamiliar, and that may vary widely depending on the nature of the event or the phase of the response," and concluding that "Safety Management Is Risk Management - Because the work of emergency responders is inherently dangerous, managing their safety is more accurately described as managing their level of risk." This thesis refers to such an approach as "safety risk management."

RAND/NIOSH further explores safety risk management, breaking the process into three iterative functions:

- Gathering information about the situation
- Analyzing available options and making decisions
- Taking action to implement decisions.

Figure 1 Safety Management Cycle - From (Jackson 2004, pg. 5)

RAND/NIOSH outlines requirements for safety risk management, specifying that it should be: “the methods, principles, and organizational structures through which the manager or managers of a response operation protect the safety and health of the responders”; that it should focus upon "ensuring that responders clearly understand the risks involved in their activities, eliminating or reducing as many of those risks as possible, recognizing any risks that cannot be fully controlled, and weighing the need for responders to carry out their duties against the dangers involved”; and that “effective risk management ensures that a response organization accepts no unnecessary risk, makes risk decisions in a way that guarantees clear accountability, and manages risk by planning.” RAND/NIOSH also provides direction for the approach HLDS responders should take in implementing safety risk management, specifically indicating that it should be an integrated approach that meets the needs of response by embedding safety risk management “into organizations' standard operating procedures to the extent possible.” This is further reinforced by the observation that the “majority of the benefits will occur only if common practices are developed and adopted by a large percentage of the responder community” (Jackson 2004, pg. 10).

Systematic engagement of the HLDS responder community in development of a safety risk management capability requires coordination and leadership at the national

level. The RAND/NIOSH report specifically identifies some of the elements to be addressed at this level, including consistent organizational structures, common terminologies, standards for equipment and other technologies, guidelines for hazard and risk assessment, credentialing, and training curricula. RAND/NIOSH further indicates that "national-level leadership could come from a range of sources, including the federal government, responder community and governance organizations, multidisciplinary standards organizations, or partnerships built among multiple agencies or organizations"(Jackson 2004, pg. 95); argues that "strategic planning and management well before the event, along with standardized systems and procedures, are key"; and concludes that "preparedness is the crux of effectiveness" (Jackson 2004, pg. 6) RAND/NIOSH also hints that the recent implementation of the National Incident Management System (NIMS) and National Response Plan (NRP) as initiated by Home Security Presidential Directive 5 of 2003 (HSPD-5) and the National Preparedness Plan based on capabilities-based planning as outlined by HSPD-8 in 2004, represent both a possible framework and a major opportunity for ensuring that safety risk management is integrated into organizational structures for responders (Jackson 2004).

C. AN ANSWER TO THE CALL: OPERATIONAL RISK MANAGEMENT AND CREW RESOURCE MANAGEMENT

As noted previously, RAND/NIOSH defines the parameters for safety risk management, indicating that HLDS responders should not accept unnecessary risk (and accordingly, *should* take necessary risks); should make risk decisions via a command and control process that ensures accountability; and should incorporate the risk management process via planning. Operational Risk Management (ORM), a standard risk management process used throughout the military to increase chances of success within high risk environments, is a clear candidate to meet these requirements. ORM focuses on the mission at hand, characterizes the risks and potential benefits involved, and develops safeguards to promote mission success. It applies a force protection approach that ensures resources and capabilities are available and sustainable, e.g. kept safe, to continually execute an operation. However, ORM may not suffice as a stand-alone process. Crew Resource Management (CRM), a human factors-based training regimen that develops team-oriented skill sets, provides a framework to systematically apply ORM. Used in conjunction with each other -- ORM embedded in CRM -- they can be

more effective. Accordingly, this thesis examines ORM, CRM, and their combination as candidates to build the logical, repeatable safety risk management capability for HLDS responder called for by RAND/NIOSH.

D. STRATEGIC PLANNING AND THE NATIONAL PREPAREDNESS MODEL AS PATHWAYS

RAND/NIOSH indicates that strategic planning is a key process in systematically addressing HLDS responder safety; that the preparedness process must occur in an integrated approach adopted by a large percentage of the responder community; and that the National Preparedness Plan based on capabilities-based planning as outlined by HSPD 5 and HSPD-8 represents both a possible framework and a opportunity for these processes.

Strategic planning describes a systematic process by which a strategy is converted into necessary actions that link inputs to outputs and outcomes to achieve a desired result. The concept of “strategy” itself is nearly universally recognizable, yet a single definition remains elusive. The U.S. Military defines it as “the art and science of developing and using political, economic, psychological, and military forces as necessary during peace and war, to afford the maximum support to policies, in order to increase the probabilities and favorable consequences of victory and to lessen the chances of defeat” (DOD 2001), while others have simply described it as “setting priorities and making choices between competing alternatives under conditions of limited resources” (Krepinevich 2000). It can be looked at as a grand design, as an approach to a problem, or as a roadmap for solving complex problems, but ultimately it is about linking means to ends. Indeed, the best evaluation of strategy is whether it actually achieves the objective it was formulated to meet in the first place. The generally recognized master of strategic planning, John M. Bryson, defines this art of translating strategy to a plan of action as the disciplined effort to produce fundamental decisions and actions that shape and guide what an organization (or other entity) is, what it does, why it does it, all with a focus on the future (Bryson 2004). He outlines “the disciplined effort” in a strategic planning cycle with the following ten components or steps (Bryson 2004):

1. Agree on a process
2. Clarify mandates

3. Identify stakeholders, mission and values
4. Conduct analyses
    a. Benchmarking
    b. Strength/Weakness/Opportunity/Challenge (SWOC)
5. Frame strategic issues
6. Formulate strategies to manage the issues
7. Review and adopt the Strategic Plan
8. Establish "Vision for Success"
9. Develop implementation process
10. Reassess

For the purposes of this thesis, strategic planning describes the processes necessary to ensure that the inputs (responders) are able to achieve outputs (safe and effective response actions) that ultimately result in the desired outcome (sustainable preparedness and response capability for HLDS).

This thesis does not develop a strategic plan, because a single author's work would not be appropriate for a process which should involve an organizational or systems approach with multiple owners and strategic planning participants. However, the initial steps of the strategic planning provide a convenient, standardized framework for derivation and discussion of key issues. This thesis uses the RAND/NIOSH report in the definition of the process, clarification of mandates and identification of stakeholders and their mission and values. The analytical process of benchmarking is applied by examining several uses of ORM and CRM within the military and by emphasizing lessons learned within the U.S. Coast Guard (USCG) and the U.S. Navy (USN). The capabilities-based planning process outlined in the National Preparedness Plan, and expected by RAND/NIOSH, is also consistent with Bryson. Using it to further define parameters for a safety risk management capability confers the added benefit of alignment with the NRP, NIMS, and associated national strategies, increasing impact and the likelihood of sufficient resources.

E. SUMMARY

This thesis explores issues that HLDS leaders must address before developing an approach to implementing safety risk management for response organizations. This

chapter outlined the mandates expressed in the RAND/ NIOSH report. These include the requirements for a safety risk management process to be used by HLDS responders and the need for national-level leadership and alignment with the NRP, NIMS, and the national capability-based planning process. It also identified ORM and CRM as reasonable approaches to fulfill the RAND/NIOSH report's requirement for HLDS responder safety risk management. Chapter 2 further examines ORM and CRM as components of a safety risk management capability. Chapter 3 benchmarks different organizational approaches to ORM and CRM with emphasis upon lessons learned from the USCG and USN, identifying best practices and key issues. Chapter 4 harmonizes the initial steps of Bryson's strategic planning cycle, as bounded by RAND/NIOSH and benchmarking, with the capabilities-based planning process of HSPD-8. The examination of these key issues provides a foundation upon which an iterative process can be built that will enable HLDS responders to meet their strategic objectives of being prepared for and safely responding to disasters, natural or intentional.

II. COMPONENTS OF SAFETY RISK MANAGEMENT

A. RISK AND RISK MANAGEMENT

Derived from the Italian word *risicare*, meaning “to dare,” risk is often defined as a product of the probability of occurrence of an accident and the consequences or impact of that accident (Bernstein 1996, pg. 8). When risk is associated with an action rather than an accident, it allows a simple way of examining both the probability of an action and the potential adverse consequences that may be associated with that action, such as injury, loss of life, economic loss, environmental damage, failure to achieve a mission, failure to achieve a strategic goal, failure to advance a national policy.

The use of risk management is not new. Because humans are and historically have been consistently vulnerable to a variety of hazards, risk management is intuitively part of successful survival strategies. Indeed, risk management was actually an overt part of some ancient societies as evidenced by an early group of “risk analysts” who lived in the Tigris-Euphrates valley about 3200 B.C. Their services were highly sought out as they were noted for their ability to characterize a problem, determine options, predict outcomes and make recommendations regarding the best path -- a combination of processes that would now be called risk management (Covello 1985).

In any type of risk management, a risk assessment must first take place. Its main objective is the determination of current or base levels of risk in a complex system. Secondary objectives are identification of the sources of failure and error, and identification of system factors that may cause the risk in the system to increase to unacceptable levels. Risk assessments essentially answer three questions:

- What can go wrong?
- What is the likelihood that it will go wrong?
- What are the consequences if it does go wrong?

Risk management then builds upon the risk assessment, providing a framework for achieving and maintaining an acceptable level of risk. Risk management implies that measures to reduce the frequency and consequences of accidents can be identified and evaluated. Risk management focuses on preventing situations that contribute to

accidents, focusing upon those that reduce both the frequency and severity of possible accidents. Risk management answers the following questions:

- What can be done to prevent accidents and to minimize their consequences?
- What alternatives are available, what trade offs must be made, and how effective are potential risk reduction efforts?
- What are the impacts of current risk decisions on future situations? (USN 2004)

B. OPERATIONAL RISK MANAGMENT

Operational Risk Management (ORM) is a decision-making tool people at all levels use to increase operational effectiveness by anticipating hazards and reducing the potential for loss, thereby increasing the probability of a successful mission (USN 2004). It is distinguishable from the many other forms of risk management by both the definition of users and by the approach to the utility of risk. In ORM, the "operational" includes all personnel who contribute either directly or indirectly to mission successes, including every person at every level involved with operations, maintenance, and support. The responsibility to characterize potential risks and compensate for them is thus spread throughout an organization, rather than being centralized in a particular department or individual. In ORM, the traditional risk management approach that risk is "bad" is not applicable. It relies instead upon a philosophy that taking calculated risks is essential for an organization. The aim is to increase the potential for mission success by reducing the risk to personnel, resources, and the environment to an acceptable level associated with a particular unit for a given situation. ORM focuses on missions, the risks involved, and the safeguards in place to ensure mission success. Beyond reducing losses, ORM provides a logical process to identify and exploit those opportunities that produce the greatest return on the investment of time, dollars, and personnel. Ultimately, ORM leads to operational success by ensuring forces are available and well prepared for execution of any plans. Within the military, ORM has become the standard process to increase chances of success within high risk environments. As Captain Dennis M. Faherty, the previous director of the U. S. Navy's ORM Program states, "the success of any [operation] is based upon a willingness to balance risk with opportunity, in taking bold, decisive action necessary to triumph" (Persons 2003). Indeed, the use of such risk-based

decision-making processes can enable a commander to boldly execute a plan with “knowing confidence instead of groundless audacity” (Beckvonpeccoz 1997, pg. 17).

The military’s implementation of ORM was based on a number of internal studies relating human error and mishaps in which faulty risk decisions placed personnel and assets at greater risk than was warranted and which resulted in the loss of personnel and equipment. Within the U.S. Coast Guard (USCG), four major marine mishaps with loss of life between 1991 and 1993 occurred, most notably the capsizing and sinking of the Fishing Vessel SEA KING at the mouth of the Columbia River. The National Transportation Safety Board investigation of this incident included two specific recommendations regarding a need for Coast Guard-wide risk assessment and management training. As a specific organization policy and set of tools, ORM was formally implemented within the USCG in 1999 (USCG 1999). The Army, Air Force, Navy, and Marine Corps developed and implemented ORM for similar reasons and along a similar timelines.

ORM can be precisely defined as: “A continuous, systematic process of identifying and controlling risks in all activities according to a set of pre-conceived parameters by applying appropriate management policies and procedures. This process includes detecting hazards, assessing risks, and implementing and monitoring risk controls to support effective, risk-based decision-making” (USCG 1999, pg. 6). In implementing ORM, the Army, Navy, and Marines now use a five step process (USN 2004), the Air Force uses six steps, and the USCG uses seven steps (USCG 1999). Diagrams of these models appear below in figure 2.

Figure 2 Examples of Military ORM Models

Upon closer examination, the differences between the various models are of limited importance, reflecting instead slightly different approaches in where to draw the boxes or circles that describe the components of ORM. Across the services, four common principles are consistent:

- Accept no unnecessary risk. While most operations entail some risk, accepting unnecessary risk conveys no commensurate benefit. The most logical courses of action for accomplishing a mission are those meeting all mission requirements while exposing personnel and resources to the lowest possible risk. ORM provides tools to determine which risk or what degree of risk is unnecessary.

- Accept necessary risk when [expected] benefits outweigh costs. It is critical to compare all identified expected benefits to their associated risks as this helps to maximize capabilities. Even high-risk endeavors may be undertaken when decision-makers clearly acknowledge that the sum of the expected benefits exceeds the sum of the costs. Balancing costs and

benefits may be a subjective process open to interpretation and ultimately the appropriate decision authority may have to determine the balance.

- Make risk decisions at the appropriate level. Depending on the situation, anyone can make a risk decision; however, the appropriate level to make those decisions is that which most effectively allocates the resources to reduce the risk, eliminate the hazard, and implement controls. Accordingly, managers at all levels must ensure their personnel are aware of their own limitations and when a decision should be referred to a higher level.

- ORM is as critical to execution as it is to planning. While ORM is vitally important in an operation's planning stages, risk can change dramatically during an actual mission. Therefore, managers and supervisors should remain flexible and integrate ORM in executing tasks as much as in planning for them.

Each of the service's ORM processes and tools are also commonly defined by three specific, temporally-based levels: time-critical or tactical; deliberate or operational; and strategic. Most actual applications of ORM occur at the tactical and operational level (USCG 1999). HLDS responders have a similar focus upon time-critical field operations and upon operational planning.

C. EXAMPLES OF ORM SUCCESS WITHIN THE MILITARY

The following examples of ORM illustrate the four principles outlined above as well as the ability of consistently applied, continuously used ORM to improve chances for mission success.

1. To Tow or Not to Tow

A USCG station received a phone call patch from a disabled vessel, via the 911 operator, that requested assistance because it was disabled and adrift. The weather was soon expected to deteriorate. A small boat was dispatched to investigate and take action as needed.

Upon arrival on-scene by the USCG small boat with the disabled vessel, the coxswain and crew found the weather conditions to be relatively steady with south winds

at 10 to 15 knots and seas at 2 to 3 feet. Personnel on the disabled boat already had on life jackets and were told to keep their life jackets on during the evolution. The coxswain proceeded to ask the operator what problems he was having with the boat. He was told that the steering was out and the battery was dead. Other than the fact that the boat was an older model boat, the coxswain felt comfortable with the way the vessel was riding in the water and had no reason to believe from his visual inspection that the boat might be taking on water or that it was not sea-worthy. Because the vessel had no anchor, power, radio, was drifting away from land, and the weather conditions were forecast to worsen, the coxswain decided that it would be better to tow the vessel into port rather than attempt to remove the personnel and let it drift. Applying the Green-Amber-Red (GAR) ORM model, the coxswain determined that with the current sea conditions, the risk of injuring someone by attempting to remove them from the boat outweighed the risks to personnel during a towing evolution. The coxswain told the owner of the boat that the Coast Guard small boat would take the disabled vessel in stern tow and that if there were any problems along the way to wave their arms to get the boat crew's attention. A few minutes later, the vessel was taken in tow using a skiff hook connection to the vessel's trailer eye bolt.

Approximately 100 feet of tow line was paid out and the vessel was towed at a speed of 4 knots. As the sea state picked up to 3 to 4 feet, the towing speed was decreased to 2 knots to compensate for the increased sea conditions. The coxswain waved his hand at the owner of the boat and the owner gave the coxswain the thumbs up signal, letting the coxswain know that everything was alright. A few minutes later the personnel on the disabled vessel had moved to the front of their boat but were not waving their arms, giving the coxswain no reason to believe that anything was wrong. A few minutes after that, however, the owner of the vessel began waving his arms excitedly at the boat crew.

The coxswain backed down to the vessel and immediately noticed that it was sitting heavy in the stern. The towline was disconnected from the disabled vessel. The small boat was maneuvered alongside the vessel and the personnel were removed with the coxswain concurrently determining that it was unsafe to attempt to de-water the vessel.

About two minutes later the vessel sank. The coxswain asked the owner of the vessel how long they had noticed that they were taking on water before they waved their arms. The owner stated that they had been taking on water over the gunwale for only a few minutes. The crew returned to the station with the personnel from the sunken vessel and moored safely without further incident.

The coxswain had determined from training, experience, and application of ORM, that the best initial course of action was to tow the vessel into port. This decision was based on several factors: 1) the boat was not taking on water upon arrival on scene; 2) the proximity of where the vessel was disabled to the nearest safe port was a short distance, approximately 3 nautical miles; and 3) the disabled vessel had no anchor on board so it could not be anchored in place. Through continuous application of ORM, the coxswain correctly determined that the best risk management action was to leave the people on the disabled boat while being towed because the sea state was not calm enough to conduct a personnel transfer safely. As the situation changed, so did the risk management equation, with the risks to the persons aboard a sinking vessel outweighing the risks associated with the personnel transfer.

During subsequent debriefs, other possible solutions for this case were discussed but the course of action taken was validated as the most appropriate in terms of risk management (USCG 2005a).

2. Navy E-2C Maintainers and the Mines of Afghanistan

A crew of maintainers for the E-2C “Hawkeye” – a carrier-based airborne early warning and control aircraft that provides radar coverage, warnings of possible threats and the exact locations of targets -- from the USS Enterprise were in the Arabian Gulf on a regularly scheduled six-month deployment and tasked to provide support for Operation Mountain Resolve. Because of the transit time from the Arabian Sea to the operating area and the E-2C's inability to refuel in-flight, the Hawkeyes needed to “hot-pump” at Bagram, Afghanistan before flying their mission, and once more for the trip back to the carrier. Several of the maintainers were detached to Bagram for the additional support associated with a crew-switch process and for any minor maintenance that might become necessary during the transits to the airfield or for the return to the carrier.

During the pre-brief and upon arrival at the field in Bagram, the five-step ORM process was employed. The operations were quick paced, on an unfamiliar airfield, and were continuously adapting to high-tempo ops. The hot refueling operation took place at one end of the runway with the recovery and shut down on the opposite end.

During the recovery of one of the Hawkeyes, an Air Force C-17 was taking off and using the same taxiway. In order to accomplish this, the C-17 inadvertently turned its exhaust on the E-2C, sending the crew's gear flying out into a field next to the taxiway. Once the dust had settled, the crew's first thoughts were to recover their gear, now scattered in the open field. However, they were aware of the hazards reviewed during their ORM sessions, one of which was the presence of minefields around the base, and considered the risk controls associated with potential "off track" operations.

Instead of following their initial impulse to enter the field and recover their gear, the crew notified airfield management about the problem and then proceeded to recover the Hawkeye without all of their equipment, including some personal protective equipment (PPE) that was normally a safety requirement. When the Army Corps of Engineers checked on the field the next day, the field was not considered a cleared area. Although the gear was later recovered without incident and eventually returned to the maintainers, the risk of inadvertently triggering a mine was considered to be very real.

Despite shortcomings in experience around minefields and in non-carrier operations, the principles of ORM were used to balance the risks of the unknown (a mine field) and the known (operating without PPE), allowing the crew to complete its unusual mission with no incidents (Sheldon 2004).

3. A Search Gone Astray… and Aground

At approximately 2100, a USCG Group Operations Center (Opcen) received a call via cell phone from a national park ranger relaying a second-hand report of a possible person in the water (PIW) near an old lighthouse site. The Group Operations Duty Officer (ODO), after consulting with the Group Command Duty Officer (CDO), the Group Commander, and the applicable District Command Center Search and Rescue (SAR) Controller, requested a 47 foot Motorlifeboat (MLB) from the USCG station near the lighthouse site to search for the possible PIW.

At approximately 2200, the MLB got underway with a four-person crew. The weather was broken with rain squalls and moderate seas of 3 to 5 feet. Using the Command and Control Personal Computer (C2PC), a computerized search and rescue planning tool, the ODO developed a parallel search pattern that could be executed just off the beach in the vicinity of the lighthouse site. This search pattern was evaluated by the District Command Center SAR Controller, who directed a reduction of track spacing from 2/10 to 1/10 nautical mile in order to improve the probability of detection. The CDO attempted to pass the search pattern to the through the station's watch stander by describing the corner points and major axis of the pattern. This was ineffective and the coxswain requested and received, via a cellular phone conversation with the ODO, the latitude and longitude of the Commence Search Point (CSP) and the 43 turn points of the search pattern. The coxswain directed two crewmembers to plot CSP and the turns onto a paper chart; the positions were also entered as waypoints into the boat's electronic Global Positioning System. The search pattern was difficult to plot due to the scale of the paper chart and was not completed. At approximately 0330 the next morning, after completing approximately 70% of the pattern, the MLB made a 90-degree turn to port in order to start an outbound leg of the search pattern. A few seconds later, it struck the center of three narrow steel groins (jetties) extending approximately 450 feet from the beach. Unsuccessful in attempts to free the MLB and taking repeated 90 to 120 degree rolls as the vessel was struck by 4 to 6 foot seas on the beam, the coxswain directed the crew to abandon the vessel. After the entire crew was in the water, the coxswain realized that the MLB's port engine was still running at an extremely high RPM. Fearing that the MLB would come off the groin and injure himself or his crew, the coxswain elected to re-board the vessel and secure the engines. The coxswain then swam to the beach to meet the other members of his crew. As the coxswain had suspected, the MLB floated free of the groin; it consequently arrived at the beach at about the same time as the coxswain.

The investigation of this mishap determined that a primary causal factor was the failure by the coxswain, the crew, the Opcen, and the District Command Center, to properly use ORM. Although an initial Green-Amber-Red (GAR) model was used by the coxswain and crew while readying the MLB for the mission, it was not formally conducted or documented. Additionally, as mission elements changed, the coxswain,

crew, and their chain of command failed to re-evaluate the risks involved. A post-incident use of the GAR model revealed that had they done so, either additional controls would have been needed – i.e. more appropriate search assets such as a helicopter for the mission and/or revision of the search parameters – or the search would have been suspended until first light. However, the on-scene ORM used by the coxswain was deemed appropriate. His decision to risk himself in re-boarding and securing the engine was correctly outweighed by the potential benefits (and actually realized benefits) of preventing the MLB from coming off of the groin under power and further damaging it and/or striking him or his crew.

Notably, many of the corrective actions taken in response to this mishap were specifically aimed at addressing ORM deficiencies. The Opcen, ODO, and GDO watchstander qualification requirements were modified to ensure a better awareness of the risks associated with nighttime operations as well as how to incorporate that understanding within an ORM construct; specific exportable risk management training was implemented for SAR controllers; and ORM and other risk management skill sets were integrated into the Ready For Operations process used to evaluate station readiness (USCG 2005a).

4. ORM for the Military Points to ORM for HLDS Responders

A key similarity between these examples is how ORM's focus upon mission and balancing risk with expected benefits either facilitated the success of the operation or could have prevented mishaps that interfered with completion of the operation. Another is that the operations involved rapidly changing environments with multiple hazards, characteristics similar to those of HLDS responders. There are also great similarities in organizational structures between the military and HLDS response organizations. These observations lead to the logical conclusion that the military's success (or lack thereof) in the use of ORM could be similarly conferred to HLDS responders.

D. CREW RESOURCE MANAGEMENT

Human Factors (HF) research focuses upon identifying, measuring, and characterizing elements associated with optimizing the performance of people. With twin objectives of safety and efficiency, HF traditionally examined the relationship between humans, machines, and the environment through the systematic application of human

sciences including psychology, anatomy/physiology, and sociology, all within a framework of system engineering. Just as importantly, HF provides a better understanding of the relationships between people and the impact of their interactions within the context of human-machine-environment systems. Historically, flight operations were the impetus to conduct HF research as well as the primary laboratory and recipient of most HF-related performance enhancements. The legacy of HF research and impact in aviation included the design of controls, displays, cabin layout, maps and charts, and communications systems; however decision-making processes and training were also major beneficiaries with aviation from HF. Prominent among these HF-related techniques and methods is what has become known as Crew Resource Management (CRM).

The concept of CRM originated in 1979, at a NASA workshop that examined the role that human error plays in air crashes (Cooper 1980). This workshop, which used research from aviation accidents during the 1970's and specific analysis of Flight Data Recorders and Cockpit Voice Recorders delved past the first cut knowledge that some 70 to 80 percent of all aviation accidents were linked to human error. Key observations that emerged were that crews did not fulfill its assigned roles on the flight deck, that flight crews made mistakes because they generally failed to make best use of readily available resources, and that these failures could be characterized by poor group decision-making, ineffective communication, inadequate leadership, and a lack of risk management (David 1996). Subsequent analyses of 35,000 reports of incidents over 7.5 years found that almost 50% had resulted from these types of flight crew errors with an additional 35% associated with similar air traffic controller errors (Billings 1984). Coupled with related research, which noted that many aviation training programs exclusively emphasized the technical aspects of flying and did not address crew management strategies, these mishap analyses led to a near consensus in commercial aviation that training and operational practices needed to place greater emphasis upon crew coordination factors and the management of crew resources (ICAO 1989). Subsequent research in Naval aviation found similar results, with one study reporting that 59% of "Class A mishaps" -- those involving serious consequences including fatality, destroyed aircraft, and major injury – were attributable to similar factors (Wiegmann 1999).

Cockpit Resource Management which uses "all available sources -- information, equipment, and people -- to achieve safe and efficient flight operations", was first labeled as such by John K. Lauber, a psychologist and member of the National Transportation Safety Board (Lauber 1987). Using HF research, which noted that pilots' behavior during routine operations significantly influenced the ability to function in stressful, workload intense situations, Cockpit Resource Management incorporated the practice of crew coordination skills normally performed in flight. It also provided for the use of personal leadership styles to foster group effectiveness. This and related research further suggested that behavior and performance changes could not be accomplished in a short period of time, even if the training was well designed. Trainees needed time to put the training in context, opportunity to practice the concepts, feedback from similarly trained peers, and continual reinforcement from management to truly incorporate lessons that would endure (ICAO 1989).

In the late 1980's and early 1990's, a growing number of airlines in the U.S. and around the world incorporated Cockpit Resource Management training. A new generation of courses that had an increased emphasis upon team building, briefing strategies, situational awareness, stress management and incorporated specific modules on risk-based decision-making strategies to break chains of errors were becoming prevalent. In accordance with a focus not just upon the cockpit, these courses became known as Crew Resource Management (Helmreich 1999). CRM training continues to be used by virtually all the major airlines and throughout all military aviation, though each service still refers to the training slightly differently, as well as within the Coast Guard as a whole. There, it is known as CRM for aviation in-flight operations, Maintenance Resource Management (MRM) for aviation ground crews and Team Coordination Training (TCT) for all personnel serving in cutters, on boats, and conducting marine safety and security activities.

E. EXAMPLES OF CRM SUCCESS WITHIN THE MILITARY

The following military CRM examples highlight how CRM facilitated the success or lack there-of, in the involved operations. As with the ORM examples, these operations involved hazardous and dynamic situations, much like many of the missions to which HLDS responders could be called.

1. A USCG Long Range Success

A USCG C-130 “Hercules” search-and-rescue aircraft got a call to prepare to search for a missing 30-year-old man in a 12-foot kayak, reported to be near a remote island in the Area of Responsibility, approximately four hours flying time. The C-130 was loaded with the maximum 62,000-pound fuel load, providing about 12 hours of flight time.

During the preflight planning, the crew contacted the District Command Center-Rescue Coordination Center (RCC). The crew discussed a number of search and flight options and departed on the mission, knowing that once they flew beyond the point where they could return directly to the airstation, they committed to landing at the nearby island’s primitive airport. No other divert options were available. However, at flight-time, the crew had not obtained confirmation through the RCC that the destination airport was operational.

After takeoff, the crew reviewed and modified the RCC-provided search-action plan. Later, the crew received information indicating that the airport lights were working and that fuel had been arranged.

Upon arrival on-scene, weather and sea conditions were good. The crew dropped a datum-marker buoy to get drift information. The aircraft’s search radar was intermittent, operating five to 10 percent of the time and greatly reducing the probability of detection. The navigator and avionicsman worked continuously to get and keep the radar up, successfully getting a few minutes at a time of active radar searching.

Darkness was falling as the C-130 completed all of the original search area, the perimeter of the islands, and a trackline search out 60 miles from the islands in the direction a drifting kayak would travel. The crew rapidly worked together to plan and prepare for another search area they had developed to the west of the original search area but realized they were running out of time to find the kayaker. Another night adrift would result in a larger search area the next day. More importantly, it meant the kayaker would spend another day exposed to the elements, perhaps without food or water.

During the second search, the crew had discussed that fact that they had only five minutes remaining (one more 10-mile leg) before they would have to depart because of

darkness. On that last leg, the radar came up for a few minutes, and the navigator saw a small blip before the radar again failed. However the C-130 continued toward the radar target and as they approached, the copilot, yelled out, "There he is; he's flashing a light." Flying over, the crew could just make out the faint outline of the kayak and the man on board. Unfortunately, because darkness had set in, neither he nor the kayak were visible when the C130 again passed over a few minutes later.

An MA-1 survival kit, which included a raft, was made ready. The raft could provide a safe place if the kayak overturned or sank and was equipped with a survival radio. The kit was dropped a few minutes later but, because of darkness, it was difficult to tell if it was close to the kayak.

The crew relayed the latest information to the RCC and was told there was a tugboat in the area. After the crew directly contacted and requested that the skipper of the tugboat divert to pick up the kayaker, the C130 orbited, dropping illumination flares to provide a visual reference for the life raft. Within an hour, the tugboat was nearby and was vectored to the raft. The kayaker had abandoned his kayak and boarded the life raft shortly after the aerial delivery; the tugboat located the man in the raft and brought him and the raft safely on board. As the C130 departed the scene to land at the nearby island, the tugboat skipper said if the aircraft had not remained on-scene to guide him, it would have been impossible to locate the raft.

As the C130 neared the island after the 10 hours of flight time, the crew was unable to tune in or identify the island’s non-directional beacon, the only navigational aid at the airport. They were also unable to contact any airport personnel until they were about 50 miles out with the time now approximately 2330. At 10 miles out, they spoke to someone at the field, located in a remote portion of the island, and were informed that there was no lighting at the airport and that the non-directional-beacon antenna had blown down during a recent storm. Upon hearing this, the C130’s flight deck got very quiet. The crew would have to identify the field and land without navigational aids or any surface lighting. They had to fly an approach into a black hole, in the rain, with a cloud deck at 700 feet, with no navigational aids. However, they had no other options at this point regarding diversion to another field.

The airport indicated that it had two old fire trucks parked with headlights pointed down the runway. On a first pass, the C130 crew could not see the airport or any sign of the trucks. The crew did everything possible to find the runway. The copilot called out altitude and airspeed; the navigator monitored and adjusted the GPS (uncertified for approaches) to provide a course to the runway heading. The avionicsman handled radio traffic with the RCC and the crew in the back of the aircraft readied everything for a rough landing. At the end of the second pass, the copilot saw a faint red glow to the left of the aircraft. Turning in that direction, the small, old fire trucks, probably from the 1950s or 1960s, became visible. Although they did not put out any appreciable light the pilot was able to make out what appeared to be the first 50 feet of the runway threshold. The C130 turned downwind on the go-around and once again reentered the clouds before making its run into what was believed to be the field. With continuous communication between the crew, the pilot controlled altitude and airspeed during the descent, while the co-pilot provided visual references. Nearing what they believed to be the field, the C-130's landing lights were turned on. The lights had been left off because when they were on, nothing but gray haze and rain was visible on the windscreen. As they flew over the trucks, the pilot flared the aircraft and touched down. Full reverse and firm braking were applied and the C130 safely landed. The C130 departed from the island the following afternoon and safely made it back to the airstation.

A post-flight review of this case clearly indicated that both the successful search and the rescue effort as well as the "routine" landing were successful primarily because of the CRM skills, especially communications, leadership, and decision-making, that were exercised by the crew (Sultzer 2003).

2. Scheduling a Naval Aviation Mishap

A Navy helicopter (SH-60) command put "all the necessary links in place" for a mishap. Despite a squared-away squadron, with a proactive safety program, it easily fell prey to not paying attention to the business at hand. Only the heads-up use of CRM skills prevented an actual mishap from occurring.

On a Thursday afternoon before a long weekend, a Navy helicopter command received a request regarding the need for transport of several machine guns and associated hardware from one Naval Air Station to another to support a Weapons and

Tactics Instructor course the following Tuesday. The tasking was straightforward but as the word filtered down, the urgency to do the mission ratcheted up.

The distance to be traveled was only 600 miles, a one-leg flight for a fixed-wing aircraft. But for the helicopters involved -- SH-60B’s -- on a good day with good winds it would be about a five-hour, two-leg flight with one stop for fuel. With any headwind, such a flight could end up requiring three legs and two fuel stops. Although weather was not really an issue, the various factors involved meant that the helicopters would have to fly visible flight restriction (VFR)-only, stay at or near a 10,000 foot ceiling, traverse unfamiliar mountainous terrain to an unfamiliar destination, and use a junior aircrew.

On Friday morning, the requirement to get the guns to the distant NAS was still valid. The operations officer had also determined that commercial-overnight delivery and the airstation's C-12 were not viable options to move the gear. After a mid-morning discussion, the ops officer, with naval aviator “can do,” said the command could do it with the scheduled aircrew and aircraft. All this transpired through the morning as the command worked "important squadron issues."

While the command had initially assumed that the aircrew would remain overnight after the delivery and return the next day, the aircrew, which consisted of a newly designated helicopter aircraft commander (HAC), a slightly more seasoned HAC as copilot, and a junior aircrewman, wanted to fly there and return the same day. The command reluctantly approved this flight schedule as all involved had the best intentions to get the job done.

The aircrew planned and filed the mission to get the gear there and fly back the same day. Due to some aircraft issues, the preflight checks were completed just before noon --approximately 90 minutes behind the originally scheduled launch; however, the crew pressed on. Shortly after that, the squadron CO walked out of his office and bumped into the aircrew milling about rather oddly in the hallway. They had come back into the squadron to reevaluate the entire mission. After getting set in the aircraft and getting ready to "start engines" on the checklist, they had a feeling in the pit of their stomachs that all was not right, causing them to return to the squadron bay. They felt the

overall planning was poor and the CO's reluctant approval of the mission was even worse. They felt a “time out” was needed.

The CO cancelled the mission on the spot. Upon closer discussion with the distant NAS, it was learned that the guns were needed no later than close of business on Tuesday. The mission was successfully rescheduled for an early start on Tuesday with an overnight and return on Wednesday.

Because of “can do”-itis, the crew and command both failed to question their motivation, did not examine the eventual course of action, and did not appropriately make good risk decisions. However, the crew’s other CRM skills came into play as situational awareness and assertiveness forced them and the command to reexamine the situation before a potential mishap could be initiated (Gillcrest 2002).

3. A USCG Search Astray - Revisited

Re-examining the third example from the above chapter on ORM, the USCG search effort that resulted in the MLB grounding, one of the other primary causal factors noted during the investigation was the failure by the crew and the chain of command to utilize CRM skills (or more precisely TCT skills for the boat crew). Of particular relevance to this thesis, the investigation’s discussion of this causal factor directly intertwines with use of CRM skills as a primary basis for ORM to be employed. Although ORM was utilized initially prior to the departure of the MLB on the case and on-scene after the initial grounding, the opportunity for the coxswain and crew (and the chain of command) to properly employ ORM – and likely prevent the mishap -- would have occurred during the team-based decision-making and communications that should have been facilitated as part of a purposeful application of CRM. The fact that they failed to use CRM resulted in a similar failure to effectively use ORM, ultimately resulting in the mishap (USCG 2005a).

F. CRM AND LINKS TO ORM

The links between CRM and ORM, as discussed in the last example, are currently a hot topic throughout military safety staffs. A recent DOD CRM workgroup’s internal benchmarking exercise of the various services’ CRM programs compared and contrasted them. They found that each service had slightly different names for the courses. All

required some form of initial and refresher training, though not for all operational communities, and each taught a different suite of skills, although each included communications and assertiveness (DOD 2005). These findings were then incorporated by the workgroup with information from commercial aviation CRM programs. From this composite set of both military and commercial inputs, the workgroup was able to characterize a "typical" CRM course. It initially takes two to three days with multiple instructional approaches that mix lectures, interactive and practical exercises, case studies, and multimedia. Specific topics for an operational community are usually established through accident/mishap analysis, subject matter expert interviews, and observations of crews in simulators. There are six core concepts: team work, leadership, situational awareness, decision making, communications, and personal limitations such as stress and fatigue. These are covered with a common skill set that includes: mission analysis, communication/assertiveness, coordination, task management, situational awareness, and decision-making/risk management (DOD 2005). Within the Mission Analysis and decision-making/risk management skills, ORM was identified as the key tool. The courses initially educate crews about the limitations of human performance and how stressors such as fatigue, emergencies, and work overload can contribute to the occurrence of cognitive errors. A number of operational concepts to help mitigate and act as filters for the error process are addressed. These include: inquiry (seeking relevant operational information), advocacy (communicating proposed actions), conflict resolution and the use of risk-based decision making processes, which is where ORM plugs in. The recent DOD working group best captured this relationship by noting that "ORM is a tool embedded in decision making and mission analysis. CRM is the human factors skill set that will enhance the application of ORM. Failures in the CRM skill set could lead to inefficient ORM" (DOD 2005).

CRM prepares a team for operational performance with the knowledge that mistakes will inevitably be made. It then facilitates the use of tools, such as ORM, that simultaneously reduce both the risk of occurrence of such mistakes and the consequences when they do. This critical linkage between ORM as tools and processes with CRM as the team-oriented training that provides the skill set to best employ ORM had long been apparent to the aviation components of the DOD services and within the Coast Guard.

Notably, non-aviation components within the military cited the existence of this linkage as well but until recently had not implemented community-wide programs to integrate ORM via CRM training. As implied by the work of the DOD working group, the consistent integration of ORM into CRM training for all military services and all communities is a likely path to be taken in the future.

G. CRM SUCCESS PREDICTS HLDS RESPONDER SUCCESS

CRM, adopted by a multitude of professions and industries besides the military (Salas 2003), has a 25-plus year record of proven success in helping operators prevent catastrophic events caused by human error (IAFC 2003). These successes include anesthesiologists (Howard 1992), air traffic controllers, the nuclear power industry (Harrington 1993), aviation maintenance (Marx 1994), the offshore oil and gas industry (Flin 1997), and within merchant fleets. Exemplifying its success is the Danish maritime and shipping company Maersk, in which CRM has been in place for their mariners since 1994 and for their rig crews since 1997. Maersk's accident rate decreased from one major accident per 30 ship years in 1992 to one major accident per 90 ship years in 1996, a three-fold reduction; additionally, by the beginning of 1998, all insurance premiums had been reduced by 15 % from their levels in 1992. These results were largely attributed to the combined use of CRM and simulator training (Byrdorf 1998).

CRM provokes the changes within an organization required to reduce accidents (Mearns 2003) and has a demonstrated track record of enhancing safety and improving productivity within sets of tasks where teamwork is important. The HLDS response community should receive a similar benefit from its integration. Within this community, particularly in firefighting, a number of pioneers and innovators are currently pushing initiatives to integrate CRM principles. The International Association of Fire Chiefs (IAFC) used a top-level team from the aviation industry, the International Association of Fire Fighters, and command officers from all types of fire departments in conjunction with successful CRM practitioners from the U.S. Coast Guard and other military aviation components to craft a CRM introduction guide for the fire service (IAFC 2003). The National Wildfire Coordinating Group has developed an introductory training program on CRM principles for the line firefighter. Several forward-leaning fire departments such as the Campbell County (WY) Fire Department (Lubnau 2004) and Phoenix (AZ) Fire and

Rescue have adopted and integrated CRM programs (Rubin 2005). A number of others, including Atlanta Fire and Rescue, are readying CRM instruction for their crews and there have been calls within the firefighting community for universal adoption of CRM (Rubin 2001a, 2001b, 2001c, 2001d, 2001e, 2002a, 2002b). Although there is little data yet available, CRM appears to be a successful approach within the fire service, one that will only receive more attention and emphasis (Rubin 2005).

H. SUMMARY

The safety risk management process called for by the RAND/NIOSH report, like other risk management processes, requires recognition, evaluation, and control of risks to HLDS responders. The principles of ORM -- not to accept unnecessary risk (and accordingly, to take necessary risks based on expected benefit), to ensure accountability for risk decisions, and to incorporate the risk management process via both planning and execution -- are strongly aligned with RAND/NIOSH's specific requirements for HLDS responders. The successful use of ORM by military responders to balance risks and mission completion in hazardous, highly dynamic environments indicates that it should be similarly effective for HLDS responders.

Whether referred to as Cockpit Resource Management, Aircrew Resource Management, Maintenance Resource Management, Team Coordination Training, or most commonly, Crew Resource Management, the application of human factors research to training and operations within the commercial and military aviation sector has significantly improved safety and effectiveness. ORM can be a key tool within a "state-of-the-art" CRM course to synergistically reduce both the probability of mistakes and the severity of consequences when they do occur. Successful applications of CRM within other military, medical, commercial maritime, and oil production communities provide mounting evidence of CRM's ability to dramatically improve teamwork and facilitate the use of all available resources to achieve safe and efficient operations. Building upon its success for firefighters, other HLDS responders should expect to reap similar benefits.

III. BENCHMARKING SAFETY RISK MANAGEMENT

A. BENCHMARKING

As noted previously, within the context of the strategic planning cycle, the RAND/NIOSH report clarified the mandate and identified the stakeholders, their missions, and their values. These can subsequently be used within the next step of the strategic planning cycle, analysis. For this thesis, benchmarking is the primary analytical tool.

By definition, a benchmark is a point of reference for a measurement. The term originated from the chiseled horizontal marks that surveyors made into which an angle-iron could be placed to set a leveling rod, thus ensuring that the leveling rod could be repositioned in the exact same place in the future. When used in a management and strategic planning context, benchmarking refers to a process in which organizations evaluate various aspects of their processes in relation to other organizations or an accepted best practice, with the ultimate aim of developing plans on how to adopt and integrate such best practices.

Selection of an organization or organizations that exhibit best practice is a key element to benchmarking. In this case, the RAND/NIOSH report provides a relatively clear and direct indication that the military was expected to provide the best practice for Homeland Defense and Security (HLDS) responder safety risk management. In particular the military's emphasis on force protection, preserving "its force's fighting strength by protecting individual servicemen and women against the threat of enemy action and by taking steps to minimize the effect of hazards on unit effectiveness, readiness, and morale," is applicable to the HLDS responder community. "Sustainability becomes key: Incidents must be managed with an eye on ensuring the readiness of response organizations to meet future challenges" (Jackson 2004, pg. 1).

For this thesis, two military services, the U.S. Coast Guard (USCG) and the U.S. Navy (USN), were selected for benchmarking risk management process. These two services were chosen because the USCG is the only service to currently integrate Operational Risk Management (ORM) within Crew Resource Management (CRM); the

USN's mission set is closest to the USCG's – both are naval services; and the USN's risk management approach very closely mirrors that of the other DOD services.

B. MEASUREMENT ISSUES

The definition of benchmarking also indicates that a measurement scheme is involved in the analytical process. Such a scheme looks at output or outcomes of the process in question. For this thesis, measurement issues are concerned with the safety of operations within the benchmarked organizations.

A recent study conducted for the Coast Guard examined the state of safety performance measurement in industry and government. It captured the perspectives of 15 consultants, 6 academicians, 11 industry representatives and 6 government agencies, many of whom were associated with nationally recognized safety programs (ABS Group 2000). In determining what information a safety measurement system should provide, the authors borrowed heavily from a 1997 study in which 21 subject matter experts in behavioral safety research were asked to identify essential properties, essential results, and other features of the best safety programs (Sulzer-Azaroff 1999). The below ranked list outlines these expectations:

1. Lowered incident rates - lower frequency of mishaps, injuries, near misses, and property damage.
2. Increased safety performance - compliance with safety protocols and decreases in unsafe practices.
3. Reduced costs - continuous downward trend, benefits outweigh costs of interventions.
4. Maintenance - permanence of results after change in personnel (i.e., driven by the culture of the organization)
5. Acceptance - commitment to safety; safety becomes an integral part of business plan and results; all personnel play active role in improving safety culture

6. Broad application - personnel can deal with other safety and health challenges; increased hazard abatement; use of technological improvements to reduce/mitigate risk

7. Rapid follow-up on safety suggestions and on work orders

8. Increased reporting of near misses and property damage-accuracy and willingness to elaborate

9. Increased positive reinforcement skills (Sulzer-Azaroff 1999)

As the ABS study noted, safety metrics may be quantitative or qualitative. Quantitative metrics may include, but are not limited to, numerical counts, percentages, and rates. Qualitative metrics may include, but are not limited to, descriptive ratings of effectiveness and efficiency, and the categorization of activity. Some examples of these metrics appear below in Table 1.

Quantitative Metrics	**Qualitative Metrics**
Number of job safety analyses performed	Effectiveness of safety training (initial and refresher)
Frequency of peer behavioral observations	Type of interventions developed through observation processes
Participation of employees on audit teams	Value of safety suggestions
Number of safety suggestions submitted	Effectiveness of safety committees
Participation of leaders in training	Reliability of peer observations as measured by a second observer
Increase in percent safe behavior observed	Employee perceptions of incident investigation procedures
Time-to-closure on safety action items	

Table 1. Summary of Safety Metrics - From (McClintock 1999)

The ABS study also found that safety measurements can generally be categorized into outcome measures, process measures, and motivation assessments (ABS Group 2000). Outcome metrics are the most common way to compare performance between organizations and among business units within an organization. For safety, outcome measures are primarily concerned with losses and potential loss sequences. These are almost universally used because safety is a prevention activity and accordingly has

associated difficulties in determining what and how to measure events that did not happen. Safety success is focused on *not* having any results, hence only failures to the process actually get measured. Process metrics provide information about the results (i.e., effectiveness or quality of effort) and activity (i.e., efficiency or amount of effort) within the safety program, while motivational assessments provide information about underlying factors within the organizational culture that facilitate or inhibit safety processes (ABS Group 2000). Each measurement type provides a different perspective on safety performance. To understand why a safety program performs at its current level and how it might improve, an organization can use a combination of these three measurement types to create a multidimensional set of proactive measures. Such an approach captures how often processes are used, the levels of risk encountered, the various risk control measures employed, and provides comparisons between actual safety results and the expected risk. Within such a construct, the stochastic nature of risk management also needs to be accounted for. Metrics that are commonly used as outcome surrogates or are included as part of such a comprehensive scorecard include: safety audit results, standards and checklist compliance, safety and risk management training participation, completion of hazard condition reports and the relative activity of safety boards, councils, and committees.

Because there is also a direct, research-proven link between proper execution of safety management system elements and the control of severely disabling injuries, closely monitoring the elements of a safety management system is another approach used for safety measurement (Grimaldi 1989). These elements include: Mishap investigation and analysis

- Leadership and administration - participation, vision, goals and standards, business plans, audits
- Communication - marketing and recognition
- Health controls, including personal protective equipment (PPE) and Occupational Medical Monitoring Program
- Safety committee requirements

- Engineering controls, both design and process
- Manager and employee training
- Organizational rules, task analysis and procedures, and task observations
- Hiring and placement requirements
- Emergency preparedness
- Purchasing controls, including contractor safety and hazardous materials
- Planned facility/equipment inspections (Bird 1990)

Clearly, sophisticated measurement schemes that incorporate and integrate all of the many available sources of safety information -- a comprehensive risk management information system (RMIS) -- would be useful, indeed almost necessary, to link goals with outcomes. Unfortunately, the use of RMIS is not yet common and the military organizations benchmarked in this thesis are only now developing them. A recent high-level study of USCG SEH risk and compliance practices provides a sense of the current state of RMIS within the military, concluding that the existing systems are inadequate. This report specifically found that:

- The existing inventory of specialty electronic and paper-based compliance tools are essentially un-integrated and non-scalable
- There is a lack of software application development standards for contingencies, succession planning, system testing and validation
- Aggregate data is not readily available to every level within the chain of command to assist in risk assessment and mitigation program prioritization
- Inadequate tools exist for assessing effectiveness in use of operational risk management (ORM), ORM training, and for documenting and sharing critical risk information (ICS 2005)

For the military, and apparently for almost all of the federal government, the only universally accepted measure that is used to compare relative effectiveness of different

risk management processes is the mishap or accident rate, e.g. number of incidents (usually lost work time is used as the standard within general industry) per 100 personnel. This rate is usually normalized with the expectation that personnel work 2000 hours per year; however, this means that populations with differing work patterns, i.e. military and civilian personnel with 24/7 readiness as opposed to a "normal" 40 hour work, are sometimes difficult to compare. For the military, another common method of normalizing the raw number of mishaps is to use platform hours, i.e. flight hours for aircraft and underway hours for ships or boats, or the actual number of platforms involved, i.e. number of ships. Again, this creates difficulties when making comparisons across communities and organizations.

Another issue with this "simple" measure involves the actual definition of mishaps. All of the military services use a tiered system from Class "A", the most serious, to Class "D", the most common, minor mishap. However, the specific definition of those classes is highly dependent upon both the service and the community within that service. For example, within the Navy, a Class "B" mishap is one in which "Reportable property damage is $200,000 total cost of or more, but less than $1,000,000; an injury and/or occupational illness results in permanent partial disability; or when five or more personnel are inpatient hospitalized" (USN 1997). Within the U.S. Coast Guard, a Class "B" mishap is one in which "(1) Any injury and/or occupational illness results in permanent partial disability; (2) The resulting cost of reportable property damage, or damage to cutters and aircraft, is $200,000 or more, but less than $1,000,000; (3) Three or more personnel are inpatient hospitalized; (4) Coast Guard small boats incur repairable damage of $50,000 or more" (USCG 2005b). Although similar, the subtle differences – three hospitalizations vs. five, boats treated differently -- could mean that an incident in one service would be not be classified the same way in the other. Another relevant example of definitional differences is at the Class "C" level in which "lost work time incidents" – the incident level most commonly used for benchmarking in general industry and across the federal government – are lumped together in the Coast Guard with all groundings, fires, and persons in the water, regardless of whether any injuries were involved. Although most accident reporting systems, including the Coast Guard's, are sufficiently sophisticated to separate out lost-work-time incidents from these other

mishaps, the standardized reports used by the various services often do not make such distinctions. This occurs for the sake of simplicity and year-to-year consistency. For Class “D” mishaps, the differences between services can be even more pronounced. Due to these potential confounders, for the purposes of this thesis, the Class “A” mishap rate, which is nearly identical across the military services in terms of definition, is used as a means of comparison. Also, because of community differences, i.e. aviation vs. afloat vs. shore, etc. any specific comparisons that a reader may infer from the mishaps rates should be applied only between like sets of operators.

C. U.S. COAST GUARD: AN INTEGRATED APPROACH

1. Background

The successful linkage between CRM and effective risk management, e.g. ORM – and one that is particularly relevant to the multi-dimensional HLDS response community – can be seen in the U.S. Coast Guard’s use of CRM, Maintenance Resource Management (MRM)) – a CRM derivative -- and Team Coordination Training (TCT) -- another CRM derivative. As noted in the examples previously, CRM is used by Coast Guard Aviators for flight related operations, MRM is used by Coast Guard Aviation personnel for Ground Operations, and TCT is used by personnel on Coast Guard cutters, on boats, and while conducting marine safety activities. Each has a separate training program and populations that receive the training but they all share similar training objectives and use ORM within the context of human factors-based team training. For the purposes of this section, each of these CRM and CRM-derived training systems used by the Coast Guard – CRM, MRM, and TCT – is collectively referred to as CRM; although specific uses of TCT or MRM are also referred to separately. CRM, with ORM integrated as the primary decision-making tool, is used throughout the entire service for crews conducting search and rescue, law enforcement, and pollution response.

Captain Walter Hanson, formerly the Chief of Afloat Safety within the Coast Guard’s Office of Safety and Environmental Health and primary author of the Coast Guard’s current TCT and ORM directives, and his assistant, Lieutenant Commander Dennis Becker, primary architect of the Coast Guard TCT training system, explained some of the decisions associated with the Coast Guard’s implementation of CRM. They indicated that similar to the history of CRM within the commercial and military aviation,

the decision to implement such programs within the Coast Guard was initially based on a number of accident analyses of aircraft and navigational mishaps. The National Transportation Safety Board reports and internal Coast Guard Mishap Analysis Reports of major incidents, including the collision of the Cutter CUYAHOGA, the collision of the Cutter BLACKTHORNE, the sinking of the buoytender MESQUITE, and the loss of life during the towing of the Fishing Vessel SEA KING, specifically noted breakdowns in key team coordination skills, including risk management. GAO audits also indicated that the Coast Guard could better employ risk management as a means to minimize mishaps while maximizing efficiency (Becker 2005).

The Coast Guard initially looked at CRM training in 1983. John Fox, an internal Performance Consultant, completed a Front End Analysis (FEA) that examined CRM training needs for the Coast Guard. The result of this FEA was Human Error Accident Reduction Training (HEART). While it was well received by the few units to which it was given, HEART turned out to have very limited impact because no service-wide training infrastructure was ever developed to disseminate it. The results of the FEA and lessons learned from the limited HEART training were later combined with other CRM research and activities. These included the landmark University of Texas research on CRM in the 1970's; the implementation of CRM within the commercial aviation industry; and the extensive research and workshops conducted by Geis and Alvarado on Vessel Resource Management and Bridge Resource Management in the 1980's using maritime bridge simulators. In particular, Geis and Alvarado's work was used to formulate the prototype of TCT in 1993. Captain Hanson then expanded upon this prototype at a 1995 workshop of Commanding Officers by asking the gathered CO's the question "What skills are most critical to effective teamwork?" The prototype and the input from the CO's were used to derive the seven critical skills currently taught within TCT. These skills were also mapped to the Coast Guard's aviation-based CRM skill set (Becker 2005).

2. Integration of ORM and CRM

Concurrent to ongoing development of TCT and CRM was an interest by the Coast Guard and all military services in ORM and other forms of risk-based decision-making. Within the Coast Guard, Lieutenant Commander Becker, Captain Hanson,

Captain Hanson's replacement, Commander Ricky George, as well as several Aviation Safety Chiefs and the Aviation Training Center in Mobile, AL, were involved with both CRM and ORM implementation efforts. Their collective experiences led them to appreciate that ORM alone would not suffice. They believed that the critical skills of CRM were also needed, noting that that ORM, if trained on alone, couldn't provide a context for consistent application of ORM tools. They concluded that developing a standalone ORM programs would be less efficient and likely less effective. This was a significant leap from the existing level of organizational ORM implementation in the other military services. As discussed in the next section, the Navy (and the Marine Corps, Air Force and Army) clearly understood the value of ORM; however, they looked at ORM as a separate training program and did not attempt to link it to the human factors-based team concepts of CRM or TCT. Instead of simply requiring additional training, the implementation strategy of Coast Guard leaders revolved around making it difficult for units and personnel to *not* use ORM as part of their daily activities. Requiring the use of ORM through a specific policy, while simultaneously providing the process and tools to meet these requirements via the existing and successful CRM training programs, facilitated this goal. The scenario-based approach of CRM imparted skills associated with successful accomplishment of everyday activities. Making ORM the primary decision making tool within this construct allowed it to be better understood and it became second nature to participants (Becker 2005).

A key lesson learned and used to improve the Coast Guard's CRM training included the observation that "buy-in" by trainees required that their instructors to have similar background and experiences for credibility. Initial instructional TCT sessions with Coast Guard personnel utilized PhD's and other scientists. Although the academic instructors were certainly experts in human factors and in the science behind the training, they were largely ineffective in getting through to students. Once the training was conducted by actual operators who had been given the necessary academic understanding and background, the training began to have impact and acceptance. Currently within the Coast Guard, it is actual operators who conduct almost all CRM and TCT training. A large proportion of these instructors are experienced Coast Guard Auxiliarists—the volunteer-only operators of the Coast Guard workforce. Another parameter specific to

TCT was the combination of a large number of required trainees (approximately 15,000 personnel on cutters, boats, and marine safety and security activities) with limited funding and training resources that necessitated a train-the-trainer approach. Although not directly linked to the decision to integrate the training programs for TCT and ORM, this certainly influenced the desire to reduce redundancies within the training system and to seek maximum performance from every training session — an approach that should resonate well with much of the HLDS response community (Hanson 2005).

3. Benchmarking Results

The Coast Guard used both root cause analysis of mishaps and post-training behavioral questionnaires to determine whether the Coast Guard's CRM approach was effective. Mishaps of interest were examined for relevant changes in human factors contributions as compared to a baseline that had been developed from historical data before CRM implementation. To facilitate such measurements, the Coast Guard had to restructure its mishap reporting to better incorporate collection of relevant human factors information. Root cause analyses of mishaps over a four year period showed that overall human error was reduced by 15 percent. The overall mishap rate was also reduced at the end of the study period to half of the baseline rate. Over the same four year study period, the behavioral questionnaires sent to individuals trained six months earlier showed a gradual increase in use of TCT skills, including application of ORM (Hanson 1996). The consistent citing of ORM, TCT, and CRM as mitigating or preventative factors during mishap investigations and in mishap reports was and continues to be another strong indicator that they have become part of the Coast Guard's culture (USCG 2005a).

Tables 2 and 3 below provide a snapshot of USCG Class A mishap data.

FY03/FY04 CLASS A AVIATION MISHAP RATES FOR ALL SERVICES

Class A Rates	FY03 USCG	USAF	USA	USN	USMC	FY04 USCG	USAF	USA	USN	USMC
Total Class A Rate	0.00	1.29	2.68	2.28	2.91	0.00	1.18	2.36	1.17	5.19
Fixed Wing	0.00	1.15	0.83	2.70	1.34	0.00	1.12	0.0	1.34	5.37
Rotary Wing	0.00	7.41	2.92	0.79	2.98	0.00	0.09	2.67	0.49	4.98
HC130	0.00	0.00	N/A	5.91	0.00	0.00	0.31	N/A	0.00	0.00
HH60	0.00	4.20	3.50	5.91	N/A	0.00	0.31	1.81	0.00	N/A

Table 2. USCG and DOD Services Class A Aviation Mishap Rates – From USCG Fy04 Aviation Safety Report (USCG 2005c)

Afloat Platforms - Class A Mishap Rates per 100,000 Resource Hours

USCG Platform	FY02	FY03	FY04
Cutters	0.25	0.23	0.32
Shore-based Boats	0.45	0.00	0.00

Table 3. USCG Class A Afloat Mishap Rates - Adapted from USCG FY02, FY03, and FY04 Afloat Safety Reports (USCG 2003, 2004, 2005d)

Within the Coast Guard, mishap rates for all classes of mishaps continue to have a downward trend. A specific link between this trend and the impact of CRM and ORM was identified in a recent workshop organized by the International Association of Fire Chiefs to examine the potential for CRM's use in the fire service. The workshop examined mishap rates before and after the Coast Guard introduced CRM and TCT in the late 1980's, finding that incident rates across the entire service had declined in 2002 by 74% (IAFC 2003). As seen in table 3 above, the cutter fleet experienced a higher rate of Class A mishaps in FY04. However, much of this rise is attributable to the need to maintain the third oldest fleet in the world. The Commandant of the Coast Guard, Admiral Thomas Collins, recently noted, "If you count the major maritime nations of the world and their navies and coast guards, we are 39 out of 41 in terms of having the oldest fleet on this planet" (Miles 2004). Despite the serious maintenance issues, Class A mishaps for cutters remain relatively low, well within a standard deviation from the three year average, and are not associated with serious injuries. Mr. Albert Kotz, the current Chief of the USCG's Office of Safety and Environmental Health, and Rear Admiral Paul Higgins, the Director for the USCG's Heath and Safety Directorate both attribute the falling rates and the four-plus year span without operational fatalities to the consistent application of ORM within the context of CRM and TCT skill sets.

D. U.S. NAVY: A SEPARATE PIECE

1. Background and Approach

The USN formally introduced ORM in 1997, two years before the USCG. Although the naval aviation community had extensive experience with CRM and risk management, the senior naval service elected to pursue ORM implementation primarily by directly training personnel on ORM skills and use of ORM tools.

The Navy's ORM instruction, originally issued in 1997 and modified most recently in 2004, describes an approach to ORM as follows:

> [ORM] provides a means to define risk and control it where possible...Every operation, both on and off-duty, requires some degree of decision-making that includes risk assessment and risk management. The naval vision is to develop an environment where every leader, Sailor, Marine and civilian is trained and motivated to personally manage risk in everything they do, thus completing all operations with minimum risk (USN 2004, pg. 2).

This instruction directs the Navy to train all personnel, commensurate with rank, experience, and leadership position. It incorporates ORM into leadership courses, General Military Training (GMT), and in specific courses that address operational employment, safety, or force protection; as well as integrating ORM into fleet tactical training, Personnel Qualification Standards (PQS), Naval and Occupational Standards, Individual Training Systems, and the Marine Corps Combat Readiness Evaluation System. The instruction recommends that each of the major type commanders (TYCOMS) should, as appropriate, issue an implementing instruction to augment this policy, including “command-specific applications and requirements." The lead TYCOM for Naval Aviation, Air Command Pacific (AIRPAC) took the most significant action, issuing a July 2001 policy message for the Navy's aviation community with the stated goal of "institutionalizing ORM for the aviation force." (USN 2001) This policy further stated that:

> ORM is not just a program for safety officers. While [safety officers] have become our subject matter experts, operators are actually in the best position to apply risk management principles to the evolution at hand (USN 2001).

Although the AIRPAC approach could have integrated ORM via existing CRM constructs, the service-wide approach by the USN attempted to provide ORM as separate training. This was likely due to the absence of CRM or a CRM-analogue within the USN afloat community and Marine Corps.

Figure 3 below outlines the most current approach to ORM within the Navy.

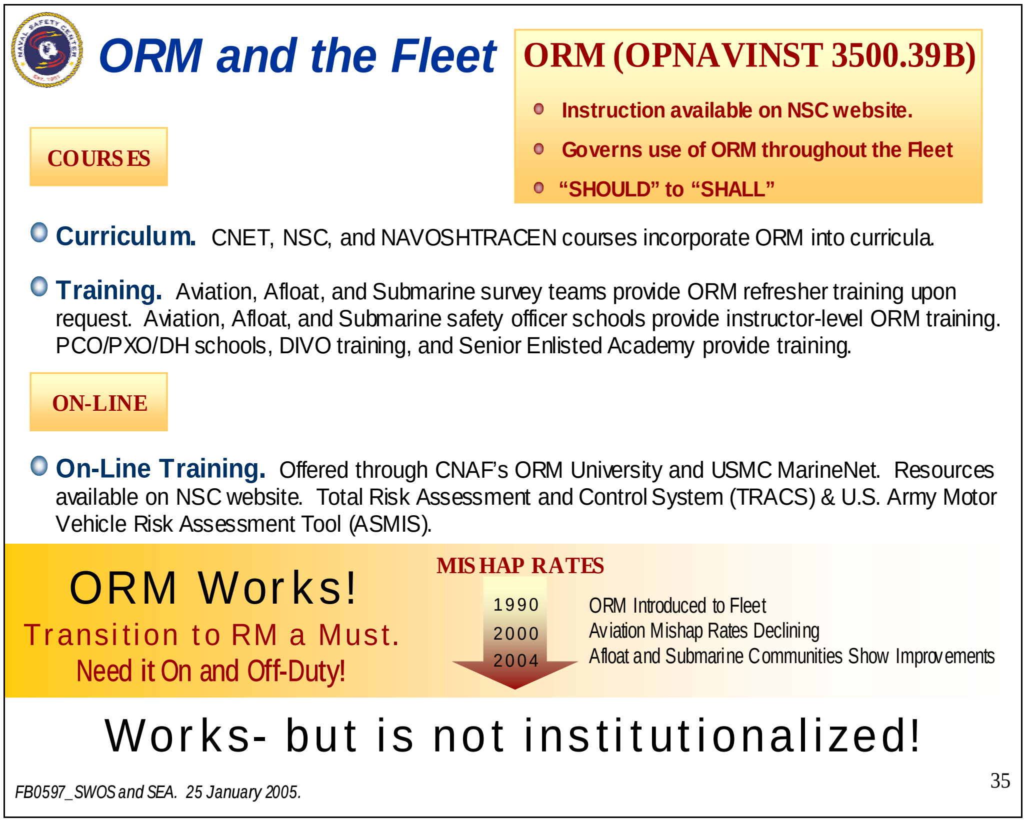

Figure 3 ORM Briefing Slide – From (Brooks 2005a)

In this briefing slide, Read Admiral Richard Brooks, the current Chief of the Navy Safety Center, clearly indicates that ORM is working, but has not been institutionalized or integrated.

This finding was also noted by the most recent (2002) Center for Naval Analysis (CNA) evaluation of the Navy's ORM program. It found that at the time, ORM had only significantly impacted small pockets of the Navy, with those almost exclusively within the aviation community, and that ORM integration generally had not become part of the culture as is desired by Navy leadership. In particular, the report indicated that ORM's integration into Navy-wide training requirement is a work in progress. Personnel at the various levels and commands agreed that in order to achieve the desired cultural change, ORM training needs a strong and continual presence in the training pipeline. But the Center for Naval Education and Training (CNET) has not yet outlined clear expectation, curriculum, or measurement schemes for ORM, nor do they control all the curricula within the various service-wide training locations. This report also noted that personnel

understand what ORM is, but not what they are supposed to do with it. Many COs don't know how to implement ORM on their ships, junior sailors can't relate to it, and senior enlisted personnel generally rely on experience and common sense, and thus don't see a need for a formal process. And although ORM faces an uphill battle in gaining acceptance, improved efforts by senior leadership could make ORM appeal to a broader range of personnel. The report indicated that Jump-start training is not a long-term solution. The high turnover of personnel dramatically lowers impact of one-time training as any proficiency that is gained rapidly "decays." However, jump-start training programs may be the only alternative until ORM is incorporated into the training pipeline. And the CNA explained that ORM is primarily identified with safety and not as part of “how business is done.” All ORM training and information comes only from the "safety side,” i.e., the command Safety Office, ship's Safety Officer, Naval Safety Center, and Traffic Safety classes. As a result it will only be seen as a safety program, and will not be taken as seriously as it should be. Thus, the Navy will not fully realize the potential non-safety benefits (increased efficiency, for example) (Mintz 2002).

2. Benchmarking Results

An examination of the Navy (and Marine Corps) Class A mishap rates in Figure 4 below finds aviation mishap rates that are higher than the Coast Guard’s. Afloat results are more difficult to compare because of normalization differences. The Coast Guard normally measure mishaps per 100,000 operational hours while the Navy measure per 100 ships. This is primarily because of the differences in operational use. Using 5000 as an approximation for the “normal” number for operational hours per USCG cutter per year, USCG cutter rates are calculated in Table 4. Comparing these to the USN’s afloat rates in Figure 5 indicate that the USN also has higher afloat mishap rates than the cutter rate of the USCG. The USN does not provide separate boat operation statistics and thus no comparisons are possible.

Afloat Platforms - Class A Mishap Rates per 100 Cutters

USCG Platform	FY02	FY03	FY04
Cutters	1.26	1.14	1.59

Table 4. USCG Class A Afloat Cutter Rates - Adapted from Table 3

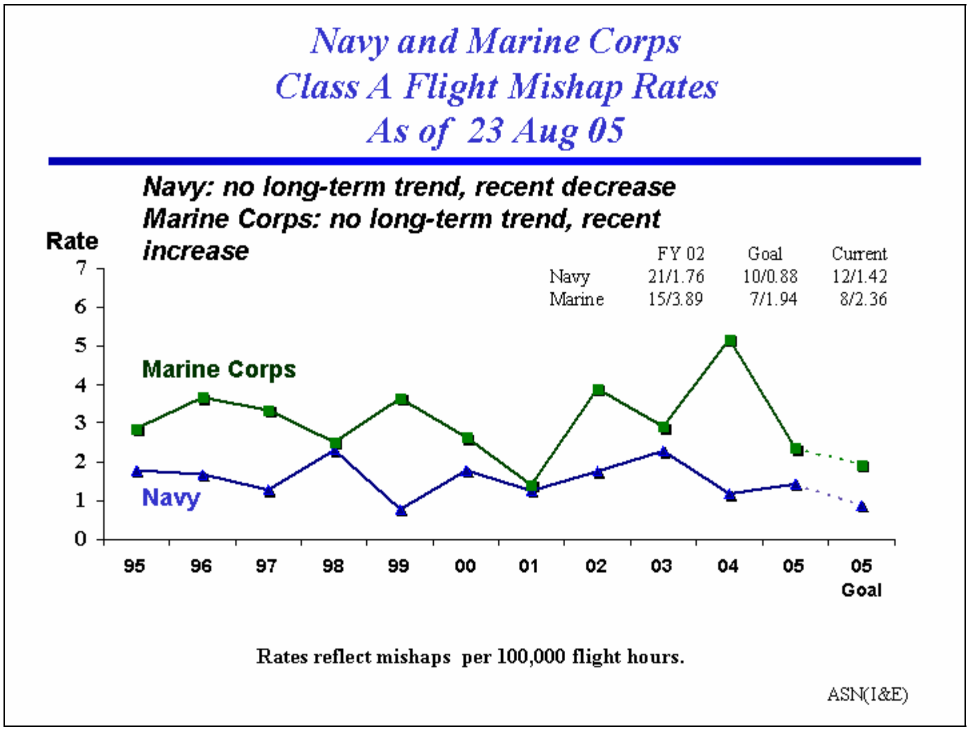

Figure 4 Navy Aviation Class A Mishap Rates – From (USN 2005)

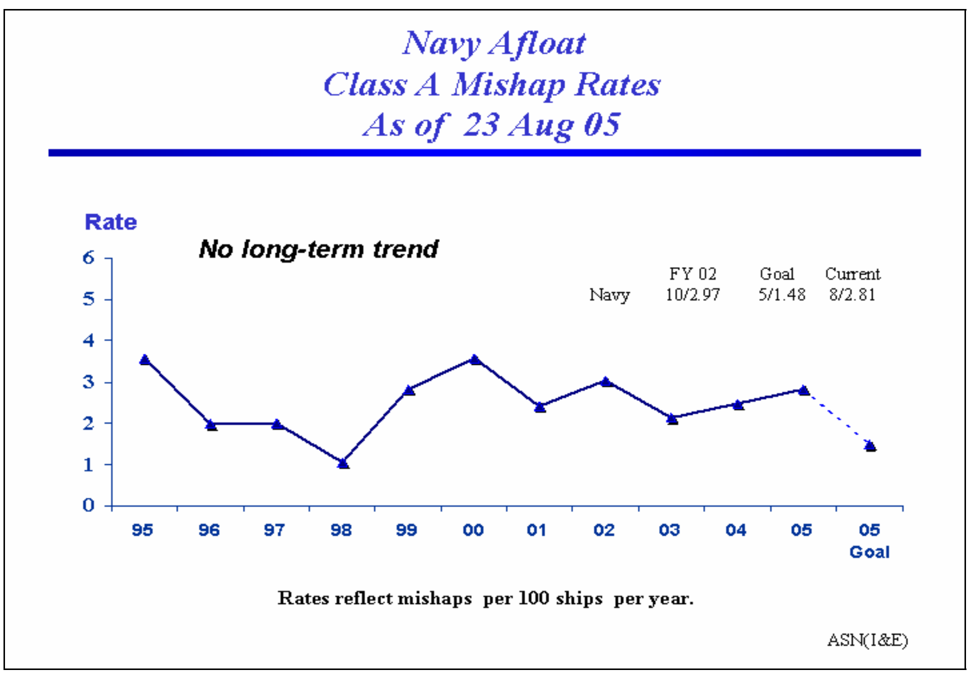

Figure 5 Navy Afloat Class A Mishap Rates – From (USN 2005)

The 2002 CNA report found that units such as AIRPAC (which integrated ORM into existing training and standard operating procedures) had mishap rates that were

lower than those of other similar commands and that their performance on service-wide safety inspections was better. Of particular note, in consideration of a desire to see ORM integrated through CRM, is that human factors continue to be the major cause of Navy Class A mishaps, as seen below in Figure 6.

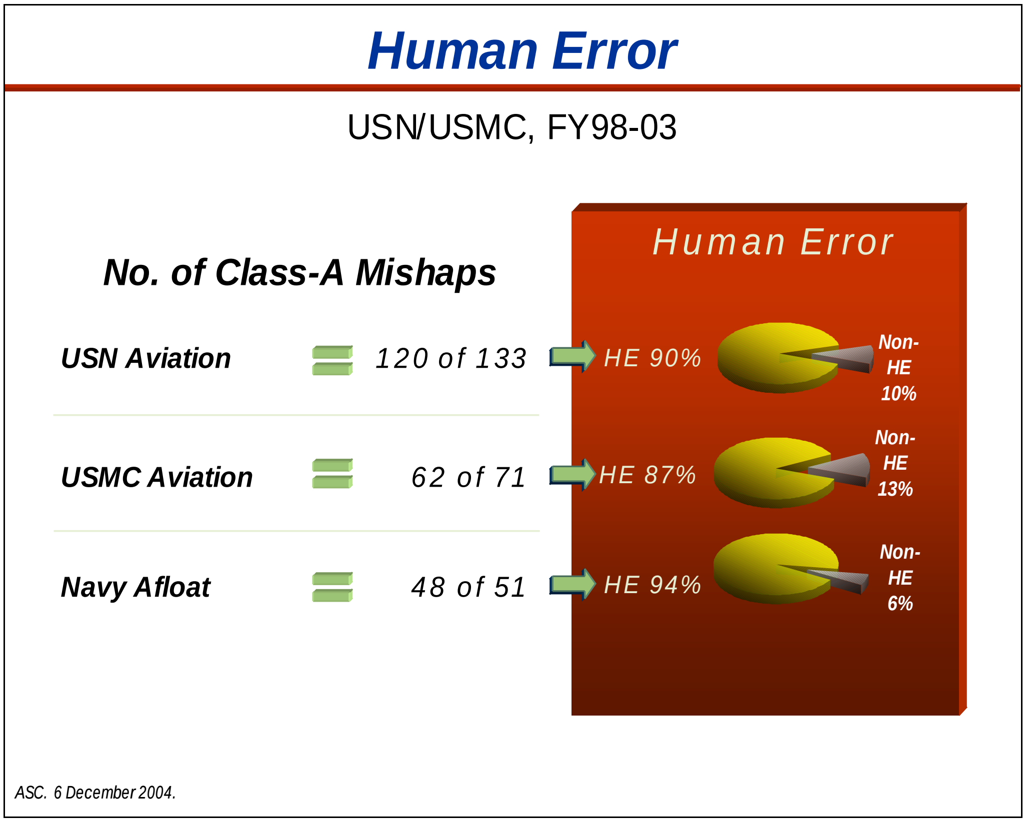

Figure 6 Navy Human Errors Statistics - From (Brooks 2005a)

ORM training and implementation have been effective in reducing USN Class A mishaps; however, based upon recent statistics, the USCG's use of ORM within the human factor's-based CRM and TCT training has been even more effective in terms of Class A mishaps. The USN's high human factor involvement in mishaps, particularly in the afloat community, also indicates that an approach, such as CRM or TCT, that focuses ORM through a human-factors lens, should make it more valuable in mishap reduction efforts. The Navy has recently come to a similar conclusion and is now undertaking efforts to develop a "roadmap for the future and the transition to a stronger safety culture" that "incorporates the principles of ORM and the tenets of Crew/Bridge Resource Management" (Brooks 2005b). Their efforts to pursue this objective and the

approach taken to achieve the goal should be an excellent source of information and inspiration for HLDS responder organizations.

E. OTHER KEY ISSUES: LEADERSHIP AND ACCOUNTABILITY

Examining the similarities and differences in the USCG's and USN's implementation of ORM highlights a number of key issues. Leadership and accountability standout as areas that need to be considered in any approach taken to address HLDS responder safety risk management.

Bryson defines leadership as the inspiration and mobilization of others to undertake collective action in pursuit of the common good. Clearly this is applicable to any organization pursuing development of safety risk management. Within the USCG, the leadership in the Afloat Safety Division of Captain Walt Hanson, Commander Ricky George, and Lieutenant Commander Dennis Becker, ensured that TCT was instituted for afloat forces and that ORM was woven into that process; hundreds of unit commanders then led their personnel in training and using the ORM tools and TCT skills. USCG aviation safety leadership, particularly Captain Dan Abel and Ms. Cathie Zimmerman, similarly insisted that ORM be a key decision-making tool within CRM; aviation unit commanders similarly championed these skills and tools to ensure their aviators employed them. The collective strategy of the afloat and aviation safety communities – make it difficult for USCG personnel to *not* utilize ORM – guided their efforts. An ability to get support for the programs has ultimately resulted in the low numbers of mishaps seen currently across the service. The USN's current efforts to institutionalize ORM, particularly within a CRM context, would not have occurred without the active "inspiration and mobilization" efforts of Rear Admiral Dick Brooks and other key members of the Navy Safety Center such as Lieutenant Commander Deborah White and Mr. Ted Wirginis. For HLDS response organization, national level leaders will be required to articulate a strategy, develop standards, and obtain resources; lower-tier and unit level leadership will be required to champion and facilitate the associated training and use of risk management. Just as Chiefs Alan Brunacini and Dennis Rubin of Phoenix and Atlanta respectively have laid the groundwork for CRM within their departments and the Nation's fire service, the collective yet diffuse leadership within other HLDS response organizations will be needed to successfully integrate ORM and CRM.

Accountability is closely linked to leadership and measurement issues. Both the USN's and USCG's implementation efforts for ORM included accountability by units to meet training or performance standards, as well as accountability up the various chains of command to make adequate resources and training available for implementation efforts. Appropriate measurement tools and schemes were critical to determining whether personnel, units, or command structures were fulfilling requirements related to ORM and CRM. In both the Navy and the Coast Guard examples, when elements of ORM and CRM programs were not measured or when leadership failed to appropriately use the measures that did exist, there were subsequent failures in performance that either resulted in mishaps or led to near miss situations. Alternatively, when the organizations made certain through accountability that ORM tools and CRM skills were properly used, the result was safe, effective completion of missions. Clearly, HLDS responders must implement processes, including measurements, that facilitate and ensure accountability if ORM and CRM are to be used effectively for safety risk management.

F. SUMMARY

Benchmarking of the USCG's and USN's approaches to safety risk management brings out key lessons regarding tools, training systems and organizational processes. Direct measurement of safety outcomes is highly problematic and despite many limitations the only universally accepted measures are accident and injury rates. ORM and CRM training programs must be taught by instructors who have a similar operational background and relevant experiences as the trainees. An integrated approach with ORM as a key tool within CRM training was more effective at reducing accidents and injuries than separate ORM and CRM training programs. And leadership and accountability must play a crucial role.

IV. SAFETY RISK MANAGEMENT AND NATIONAL PREPAREDNESS

A. THE NATIONAL PREPAREDNESS PROCESS

The President issued HSPD-5 in February, 2003. It outlined domestic incident management requirements and directed the Department of Homeland Security (DHS) to lead a coordinated national effort with other Federal departments and agencies and state, local, and tribal entities to establish a National Response Plan (NRP) and a National Incident Management System (NIMS). HSPD-8, a companion to HSPD-5 was released later in December of 2003 and described the national preparedness process, requiring DHS to again lead a coordinated national effort to develop an all-hazards preparedness goal and realign requirements in a wide range of areas to support this goal.

NIMS provides the Nation's first responders and authorities with a consistent framework for incident management at all jurisdictional levels regardless of the cause, size or complexity of the incident. It creates a foundation for incident management regardless of whether the response involves a terrorist attack, a natural disaster, or some other emergency. The NRP is an all-discipline, all-hazards plan for the management of domestic incidents. Using the template established by the NIMS, the NRP provides the structure and mechanisms to coordinate and integrate incident management activities and emergency support functions across Federal, State, local and tribal government entities, as well as private sector and non-governmental organizations. The National Preparedness Goal (NPG) establishes readiness priorities, targets, and metrics, answering three key questions: "How prepared do we need to be?" "How prepared are we?" and "How do we prioritize efforts to close the gap?" The NPG enables entities across the Nation to more easily pinpoint capabilities that need improvement and sustain capabilities at levels needed to manage major events using the protocols established by the NRP and NIMS (ODP 2005). In essence, the NRP defines "what" needs to be done to manage a major incident, the NIMS defines "how" it needs to be done, and the NPG defines "how well" this needs to be done.

The NPG uses capabilities-based planning, which asks the following questions to help develop and maintain the capabilities to prevent, respond to, and recover from major incidents as described in the NRP and NIMS:

- What should be prepared for?
- What tasks need to be performed?
- Under what conditions and to what standards should the tasks be performed?
- Which of these tasks are most critical?
- What capabilities are required to perform these critical tasks?
- What levels of these capabilities are necessary?
- How can the necessary capabilities be developed and maintained?
- What capabilities does a specific entity need to develop and maintain?
- How should an entity determine if they have the necessary capabilities?
- How should an entity allocate resources to maximize impact on preparedness?

B. THE UNIVERSAL TASK LIST (UTL)

The capabilities-based planning process starts with the use of a wide range of possible scenarios that illustrate the potential scope, magnitude, and complexity of major events that should be prepared for. Using the all-hazards approach dictated by HSPD-5 and HSPD-8, these scenarios bound the expected hazards, focusing responder examination of capability requirements.

Based on these National Planning Scenarios, a Universal Task List (UTL) was developed to provide a comprehensive menu of tasks to be performed, sorting the tasks by scenario, mission, function, and level of government that generally performs the task. It identifies the tasks that must be performed under various circumstances within the four homeland security mission areas -- Prevent, Protect, Respond, and Recover -- providing a common frame of reference useful for a wide variety of users. It highlights critical or "mission essential" tasks, in which failure will result in the loss of lives or serious

injuries, or which will jeopardize the ability to accomplish mission-level outcomes The UTL also includes lists of conditions to guide definition of environmental variables that may affect task performance, as well as measures of performance and criteria associated with each task. These are used as a guide to define performance standards, consistent with mission requirements. Such standards provide the basis for planning, conducting, and evaluating both training and actual operations. These also provide the foundation for training and exercise programs as well as for doctrine development, identification of personnel requirements, logistics needs, and interagency and inter-jurisdictional coordination. (OSLGCP 2005a)

Version 2.1 of the UTL uses a taxonomy that first organizes tasks according to the four homeland security missions. Tasks that are found throughout the mission areas, such as broad planning, coordination, training, and communication, are cross-identified as common tasks. Next is the objective level which outlines the activities required for support of missions. This level maps the approximately 1,600 unique tasks that will need to be performed by Federal, State, local, and tribal jurisdictions and the private sector to prevent, protect against, respond to, and recover from events.

In summary, the UTL can be used:

- to define mission requirements in terms of tasks that must be performed, identifying responsible organizations at all levels that play a role in performing those tasks
- to define the knowledge, skills, and abilities needed to perform these tasks, providing the basis for training plans, for executing training and for planning exercises
- to define the criteria for assessments of preparedness and for evaluation of performance during exercises and real world events
- to define a common index for sharing lessons learned and best practices (OSLGCP 2005a)

C. THE TARGET CAPABILITIES LIST (TCL)

The Target Capabilities List (TCL) was developed from the UTL, with each capability linking a measurable outcome to one or more critical tasks. The level -- amount and proficiency -- of a capability required from all sources -- Federal, State, local, tribal, and private sector – needed to achieve an outcome is also included, as well its key attributes, i.e. appropriate measures of effectiveness, supportability, time,

distance, effect (including scale), and obstacles to be overcome. Recommended combinations of planned, organized, equipped, trained, and exercised personnel necessary to achieve an outcome are provided for illustration purposes. The TCL also includes summaries that cut across the scenarios to emphasize different levels of capability needed by each level or source (OSLGCP 2005b).

The TCL is organized in the same taxonomy as the UTL. Capabilities are mapped to missions, objectives, and functions. Additionally, they are focused upon tiers or classes of jurisdictions, allowing for reasonable differences in target levels of capability based on characteristics such as total population, population density, and critical infrastructure. Another purpose of this tiering is to encourage development of mutual aid agreements among neighboring jurisdictions. The TCL also provides guidance on the specific capabilities and levels of capability that groups of jurisdictions are expected to develop and maintain (OSLGCP 2005b).

Entities at all levels of government use the TCL to determine "gaps" (implying that tasks or missions cannot be accomplished with current capabilities); "excesses" (unnecessary redundancy exists or a specific capability is no longer needed); and "deficiencies" (a capability exists, but is insufficient to meet the target level of capability). This process builds from existing capabilities of entities, enabling all levels of government to assess needs, define priorities, and appropriately allocate resources. Funding and responsibility for new capabilities is spread among Federal, State, local, tribal and private sector entities based on authority and role, as well as factors such as required response time, the cost to acquire and maintain a capability, projected frequency of use, degree of specialization, and required lead time for research and development. (OSLGCP 2005b)

In summary, the TCL is designed:

- to assist jurisdictions and agencies in understanding and defining their respective roles
- to outline the capabilities required to perform a specified set of tasks

- to indicate where to obtain additional resources if needed
- to summarize group capability by UTL mission, objective, and function

D. BUILDING SAFETY RISK MANAGEMENT

As noted previously, building a safety risk management capability via the capabilities-based planning process will be vitally important to HLDS response organizations. However, the current limits of the UTL and TCL preclude them from being effective guides in this process. Both the UTL and TCL will require additions and modifications if they are to provide appropriate guidance for organizations building safety risk management capabilities, especially if they are based on ORM and CRM.

Within the TCL, only the specific capability of "Worker Health and Safety" is relevant to CRM and ORM. This is described by the TCL as:

> The capability to protect the safety and health of on-scene first responders, hospital personnel (first receivers, skilled support personnel and, if necessary, their families) through an effective safety and health program that includes training, personal protective equipment, health and safety planning, risk management practices, medical care, decontamination, infection control, adequate work schedule relief, psychological support, and follow-up assessments of exposed first responders (OSLGCP 2005b, pg. 82).

It outlines the expected outcome from the capability as:

> No further harm to any first responder, first receiver, hospital staff member, or other skilled support personnel due to preventable exposure to secondary trauma, chemical release, infectious disease, or physical and emotional stress after the initial event or during decontamination and event follow-up (OSLGCP 2005b, pg. 82).

While this expectation certainly aligns with ORM and CRM contributions to an HLDS response organization, the TCL and the additional information it includes – "Emergency Support Function" and "Annex" references to the NRP, "UTL Critical Tasks", "Capability and Performance Measures", and "References" -- are not detailed or focused towards such a comprehensive approach to safety risk management. The CPL sections on "Equipment and Systems" and "Training" do not presently include requirements for either risk management processes or for human factors or risk management training. However UTL Task Res.B.1.16.5, "Monitor and Perform Activities Related to Worker

Health and Safety", and the TCL's "Performance Measures" related to ensuring usage of "hazard-based responder safety measures" reflect good interim points for an organization to link safety risk management processes to the national capabilities based planning model (OSLGCP 2005a, 2005b).

This review of the national capability-based planning process and it's applicability to safety risk management identified several key issues that align directly with those developed distilled from Bryson's strategic planning process and benchmarking. Most notable of these are measurement, leadership, and accountability. Specifically, to build an HLDS organization's safety risk management capability, the TCL's measures need to add relevant metrics for worker risk levels during operations and for evaluating training associated with the ability to apply risk management and team coordination skills. Leadership at both the national and local level is clearly needed to influence the continued development of the UTL and TCL such that they include these measures as well as training requirements related to risk management and team-based training. And accountability's link to measurement, as identified previously, is important to ensure that safety risk management measures which may be developed and integrated into the UTL and TCL are actually applied and used for identifying gaps in required capabilities. The national capabilities-based planning process is likely to become the standard for organizations to indicate whether they have met readiness requirements. Without inclusion of program requirements and applicable metrics, organizations cannot hope to obtain or allocate resources necessary to build a safety risk management capability.

E. SUMMARY

The national capabilities planning process outlined by HSPD 5 and HSPD 8 align Federal, State, local, tribal, private sector, and non-governmental preparedness, incident management, and emergency response plans into a coherent national structure. While clearly this is the process through which HLDS responders should build a safety risk management capability based on ORM and CRM, strong leadership is needed to ensure the Universal Task List (UTL) and Target Capabilities List (TCL) are refined to provide specific measures, guidance, and accountability related to safety risk management.

V. CONCLUSIONS AND RECOMMENDATIONS

As the RAND/NIOSH report indicates, great opportunity exists to build upon the foundation of existing systems and capabilities in order to improve preparedness and protect HLDS responders, especially the organizational structures needed to manage response safety. Given that the "emotionally charged, chaotic environment in the immediate aftermath of a major disaster is not the time to start working on procedures or guidelines to improve responder safety," the RAND/NIOSH report provides the raw materials to begin such critical efforts now.

RAND/NIOSH mandates development of a safety risk management approach that improves responder safety and effectiveness; identifies HLDS responders as stakeholders; makes the implicit recommendation to benchmark military risk management approaches; and suggests the capabilities-based planning process of HSPD-5 and HSPD-8 as a potential pathway. Based on these premises and lessons learned from the use of Operational Risk Management (ORM) and Crew Endurance Management (CRM) by the Coast Guard and the Navy, this thesis has derived the following key recommendations:

1. HLDS responders should employ ORM as the primary risk tool for management of safety.
2. HLDS responders should incorporate ORM into planning, training, and mission execution through CRM.
3. ORM embedded into CRM skill sets is the most appropriate approach to a safety risk management capability.
4. National and local officials must provide strong leadership
    a. to ensure that safety risk management components, including measures and accountability, are included in the HSPD-8 national capability-based planning model;
    b. to champion the adoption of safety risk management within the individual responder communities; and

c. to change organizational cultures and ensure that ORM and CRM can be integrated across the HLDS responder community.

Using the strategic planning model, these recommendations can be expressed in terms of a strategic goal and vision:

Strategic Goal: Improve safety, enhance mission effectiveness and sustainability, and increase the operational readiness of HLDS responders

- through CRM's human-factors based integration of ORM tools that enables
- recognition of risks to people, platforms, equipment and mission readiness; evaluation of these risks; and control and management of the risks
- in accordance with the following principles:
    - accept no unnecessary risk
    - accept necessary risk when benefits outweigh costs
    - make risk decisions at the appropriate level
    - use ORM continuously in executing as well as in planning
- by integrating these safety risk management components into the national capabilities-based planning process.

Strategic Vision: Well prepared, HLDS responders who systematically use CRM skills and principles to employ ORM, increasing their effectiveness, sustainability and the safety of their teams and the public.

This goal and vision, in combination with development of comprehensive safety metrics, accountability and especially strong leadership, can form the basis for future development of a comprehensive approach aimed at building a safety risk management capability for HLDS responders. Such an approach should provide the tools, the training, and the capabilities to enable them to meet the strategic objective of safely and effectively providing their vital services to the Nation and its citizens

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